

Title: With Due Reflection**Brief Overview:**

This lesson investigates reflections done on a coordinate plane. In it, students will measure lengths and angles on preimage and images to see that distances and angle measures are preserved. Students will use the TI-92 calculator to reflect triangles over the x-axis, the y-axis, and the line, $y = x$. Students will explore patterns and develop rules that describe these reflections.

Link to Standards:

- **Reasoning** Students will use logical reasoning skills to make and test conjectures.
- **Communication** Students will write their observations, conjectures and conclusions.
- **Connections** Students will connect algebra and geometry by placing triangles on a coordinate plane and manipulating their vertices as ordered pairs.

Grade/Level:

Grades 9-12, Algebra and Geometry

Duration/Length:

3 class periods (45 minutes each)

Prerequisite Knowledge:

Students should have the following:

- Novice expertise with TI-92 calculator
- Knowledge of the vocabulary of triangles (vertices, scalene)
- Knowledge of coordinate plane (plotting points, graph of line $y = x$)

Objectives:

Using the TI-92, students will:

- draw and reflect a scalene triangle.
- measure lengths and angles on both pre-image and image.
- draw and reflect a scalene triangle on a coordinate plane.

- label vertices with coordinates.
- reflect triangles about the x-axis, y-axis, and the line $y = x$.
- determine rules to govern the reflections.
- develop skills in manipulating and visualizing congruent figures.

Materials/Resources/Printed Materials:

- TI-92 graphing calculator
- Student Work Packet

Development/Procedures:

- Each pair of students will receive a TI-92 calculator and a packet of worksheets to guide them through an exploration of the effects of reflecting triangles on a coordinate plane.
- Students will record results of each exercise on the worksheets provided.
- Using the results, students will work together to determine the rules which describe the reflections and will write them using correct notation.
- Students will measure the sides and angles of both pre-image and image to see that both distances and angle measures are preserved in reflections.

Evaluation:

Students will complete the worksheet packet and assessment.

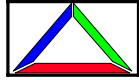
Extension/Follow-up:

Mirror problem

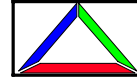
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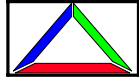


With Due Reflection

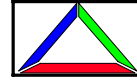


	STATEMENT	CALCULATOR STEPS
1.	Set Up	Applications 8 1 (current) F8 9 Cursor to Display Precision: FIX 1 Enter
2.	Draw and label vertical line n	F2 4 Enter Up Cursor n Enter
3.	Draw and label scalene triangle to one side of n	F3 3 Cursor moved to location Enter 1 A Cursor (Draws 1st side) Enter 1 B Cursor (Draw 2nd side) Enter 1 C
4.	Reflect	F5 4 Cursor to side "Reflect this Triangle" Enter Cursor to line n "With respect to this line" Enter
5.	Label the 3 vertices to make $\triangle DEF$	F1 Enter F7 4 Cursor to vertex "this point" Enter 1 D Cursor to next vertex "this point" Enter 1 E Repeat for F Enter

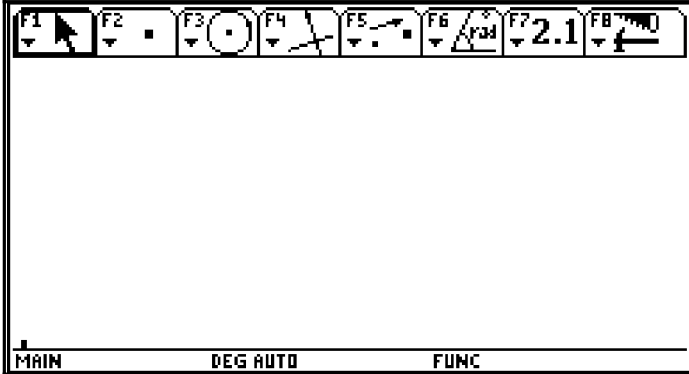
6.	Measure the 3 sides of both triangles	F6 1 Cursor to vertex “from this point” Enter Cursor to next vertex “to that point” Enter Repeat to get lengths of remaining sides Repeat for $\triangle DEF$
7.	Measures all angles	F6 3 Cursor to vertex A “this point” Enter Repeat for vertex B & C Enter (This identifies $\angle ABC$ and gives angle measurement. Measure the remaining angles.)
8.	Coordinate Plane	F8 9 Coordinate Axes: Cursor right to 2- Rectangular Grid: Cursor right to 2-On Enter
9.	Label vertices with ordered pairs	F6 5 Move cursor to vertex “Coordinates of this point” Enter Repeat for all vertices
10.	Hints: To move numbers & letters Show Page	F1, Enter, cursor to object, Enter, hold hand down, drag using cursor F8,A, Move cursor to box, drag



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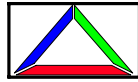
Worksheet #1: An exploration of congruent triangles by measuring corresponding parts



1. Draw line n .
2. Draw scalene $\triangle ABC$.
3. Label vertices.
4. Reflect $\triangle ABC$ over n .
5. Label as $\triangle DEF$.
6. Measure all sides and angles.
and record data.
7. Sketch your calculator screen.
on template at left.

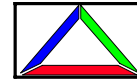
Sides/Preimage	Sides/Image	Angles/Preimage	Angles/Image
AB	DE	$m\angle A$	$m\angle D$
BC	EF	$m\angle B$	$m\angle E$
AC	DF	$m\angle C$	$m\angle F$

1. Compare the sides and angle measures of the two triangles. List all your observations.
2. Make conjectures regarding similarities and differences of these two triangles.
3. Are the triangles congruent? Explain why or why not.
4. Complete the statement: $\triangle ABC \cong \triangle$ _____.



With Due Reflection

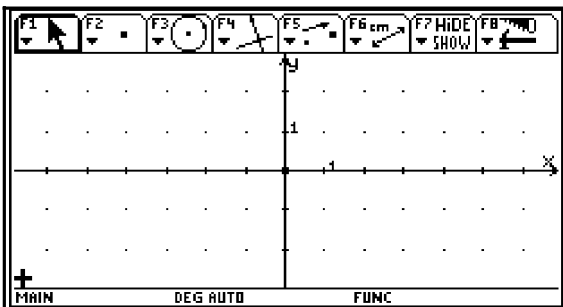
Worksheet #2: Reflection over the x -axis



R_x indicates a reflection over the x -axis.

R_x : (,) (,)

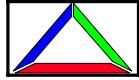
Reflection so that point of moves to **corresponding**
in x -axis preimage point of image



1. Draw a scalene $\triangle ABC$ in quadrant I.
2. Reflect the triangle over the **x -axis**.
3. Check: Did you use the **x -axis** or not?
4. Label vertices with coordinates.
5. Sketch your calculator screen on template at left.
6. Fill in chart below.

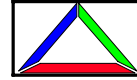
Preimage		Image
A (,)	\square	A (,)
B (,)	\square	B (,)
C (,)	\square	C (,)

1. Compare ordered pairs of the preimage and image. Describe any patterns that you observe.
2. Complete the statement:
For any point (x,y) , $R_x : (x,y) \rightarrow (,)$



With Due Reflection

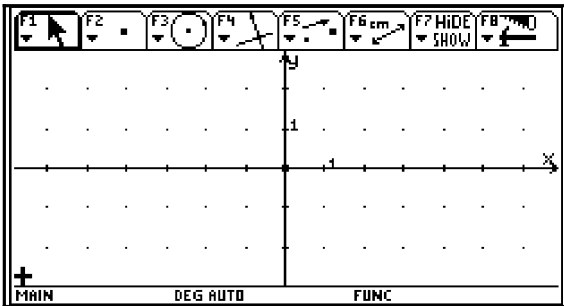
Worksheet #3: Reflection over the y-axis



R_y indicates a reflection over the y-axis.

$R_y : (\quad , \quad) \rightarrow (\quad , \quad)$

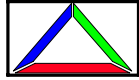
Reflection in y-axis so that point of preimage moves to corresponding point of image



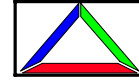
1. Draw a scalene $\triangle ABC$ in quadrant I.
2. Reflect the triangle over the **y-axis**.
3. Check: Did you use the **y-axis** or not?
4. Label vertices with coordinates.
5. Sketch your calculator screen on template at left.
6. Fill in chart below.

Preimage		Image
A (,)	\square	A (,)
B (,)	\square	B (,)
C (,)	\square	C (,)

1. Compare ordered pairs of the preimage and image. Describe any patterns that you observe.
2. Complete the statement:
For any point (x,y), $R_y : (x, y) \rightarrow (\quad , \quad)$



With Due Reflection

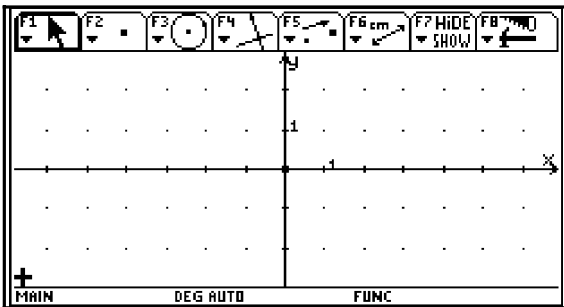


Worksheet #4: Reflection over the line $y=x$

$R_{y=x}$ indicates a reflection over the line $y = x$

$R_{y=x} : (\quad , \quad) \quad (\quad , \quad)$

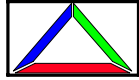
Reflection in $y=x$ so that point of preimage moves to corresponding point of image



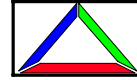
1. Draw the line $y=x$ on grid.
Recall $y=x$ has a slope of 1 and passes through the origin. Use the grid to get an accurate line.
2. Draw scalene $\triangle ABC$ on one side of the line $y=x$.
3. Reflect the triangle over the **line $y = x$** .
4. Check: Did you use the **line $y = x$** or not?
5. Label vertices with coordinates.
- 6 Sketch your calculator screen on template at left.
7. Fill in chart below.

Preimage		Image
A (,)	\square	A (,)
B (,)	\square	B (,)
C (,)	\square	C (,)

1. Compare ordered pairs of the preimage and image. Describe any patterns that you observe.
2. Complete the statement:
For any point (x,y) , $R_{y=x} : (x, y) \quad (\quad , \quad)$



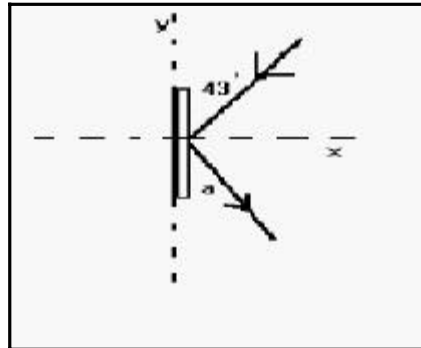
With Due Reflection



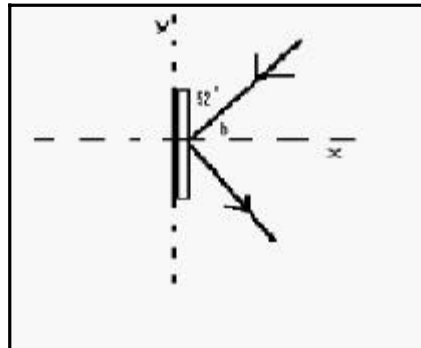
Worksheet #5: An application with mirrors

When a light ray strikes a plane mirror, it is reflected so that the angle between the incoming ray and the mirror (angle of incidence) is congruent to the angle between the reflected ray and the mirror (angle of reflection).

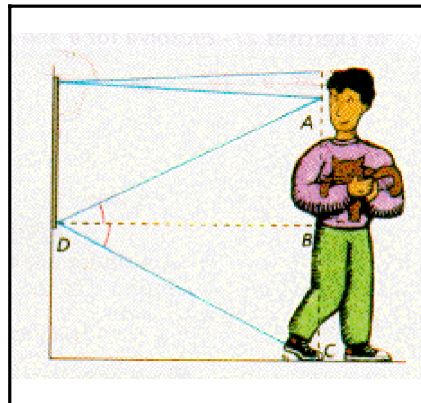
1. $m\angle a = \underline{\hspace{2cm}}$



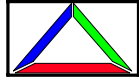
2. $m\angle b = \underline{\hspace{2cm}}$



3. If Norm, who is 6' tall, admires his reflection while standing 8' from a mirror, then what is the minimum height the mirror can be so that Norm sees his entire reflection?



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Worksheet #6: An assessment

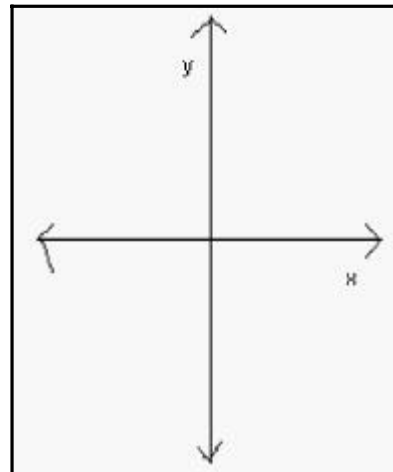


- Write a rule to describe what must be done to the coordinates of the preimage to get the coordinates of the image of a reflection over the line $y = -x$?

- Show the coordinates of both the quadrilateral and its image using the given rule. Illustrate your example.

$$R_x: (x,y) \rightarrow (x,-y)$$

<u>Preimage</u>	<u>Image</u>
A(,)	A (,)
B(,)	B (,)
C(,)	C (,)
D(,)	D (,)



- Draw the line $y=x$. Draw a segment that does not intersect the line $y=x$
 - Reflect the segment over the line $y=x$ by using the rule that the line of reflection cuts in half, and is perpendicular to, any line connecting a point in the preimage with the corresponding point in the image.
 - Describe the transformation.